

RETURN

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TO AN ORDER OF THE HOUSE OF COMMONS, dated February 26, 1912, with reference to a copy of all reports, surveys, &c., made or prepared during the year 1911 or 1912, in respect of or in connection with the Hudson Bay Railway, or the suggested ports at Nelson or Churchill, or relating to the navigation of the Hudson Straits.

W. J. ROCHE,
Secretary of State.

DEPARTMENT OF THE NAVAL SERVICE—HYDROGRAPHIC SURVEY.

OTTAWA, January 10, 1912.

SIR,—I beg to enclose you preliminary report from Capt. Anderson on the subject of his trip to and from Hudson Bay during the last season in connection with the work at Port Nelson. This is very much what will be printed in the annual report to be forwarded you later with chart and plans.

I am, sir,
Your obedient servant,

WM. J. STEWART,
Hydrographer.

The Deputy Minister,
Naval Service Department,
Ottawa, Ont.

DEPARTMENT OF THE NAVAL SERVICE—HYDROGRAPHIC SURVEY.

OTTAWA, January 9, 1912.

W. J. STEWART, Esq., C.E.,
Chief Hydrographer, Dept. of Naval Service,
Ottawa, Ont.

SIR,—I beg to submit the following report on the work of the survey in Hudson Bay and strait during the season of 1911, also a general description of the trip up and the return journey in the autumn.

The C. G. S. *Minto* and schooners *Chrissie C. Thomey* and *Burleigh* were fitted out for the work at Halifax during the latter part of June and the beginning of July and sailed on July 8, arriving at Sydney at noon on the following day.

After coaling the *Minto* cleared Sydney on July 18, with the *Burleigh* in tow, the carrying 40 tons of coal to be transferred later to the *Minto*. Besides the ship's company the *Minto* had two passengers on board, the Rev. Mr. Peck and Mr. Brough-

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ton, both missionaries bound for Lake Harbour in Baffin Land on the north shore of Hudson Strait, the supply for these missions being on board the schooner *Burleigh*.

The *Minto* called at Forteau Bay on the Labrador coast on July 20 to pick up the *Chrissie C. Thomey* also bound for Port Nelson, and the coaling steamer *Beatrice*. This fleet having assembled the harbour was cleared on the morning of the 22nd, the *Beatrice* towing the *Burleigh* and the *Minto* towing the *Chrissie C. Thomey*.

The weather was very thick with a heavy roll from the southeast and many scattered icebergs were passed. We swung ship off Battle Harbour and found the standard compass good.

Sunday, July 23, was very thick accompanied by rain, fresh wind and heavy swells from the southeast.

At 8 a.m. we were about 25 miles off Sandwich Bay with a few icebergs and no field ice in sight.

When about 25 miles off Indian Harbour and at 10 p.m. a report was sent to Ottawa by wireless, as this was the most northerly wireless station in operation and therefore the last point through which communication could be sent before proceeding farther.

On the following morning there still remained a heavy south easterly swell and the weather was very foggy and many scattered icebergs were passed during the day. The *Beatrice* with the *Burleigh* in tow had dropped to about five miles astern. Noon observations placed us about 65 miles off Turnavik.

On Tuesday, the 25th, the first ice was met about 25 miles off Cape Mugford. It was not at all heavy nor closely packed and the *Minto* with the *Chrissie Thomey* in tow, took it easily. It is impossible to state how far this ice extended off shore, but from aloft no clear water could be seen ahead or to the eastward.

Under these conditions the captain of the *Beatrice* refused to proceed but wished to heave to until the ice cleared away and then make the bay, but this arrangement was considered too indefinite and uncertain, as coal was a most serious consideration to us. Accordingly the *Beatrice* turned back with instructions to report to Ottawa from the nearest wireless station. The *Minto* took both schooners in tow. Navigation in ice is difficult enough when alone, but much more so when hampered with two vessels in tow, yet good progress was made.

No coal was taken from the *Beatrice* as I considered the *Minto* was quite low enough in the water for the ice usually met with in Hudson straits. The lower edge of the cargo doors was about 2 feet below the surface of the water and it would be a very serious matter if one of them was damaged in the ice. These doors were backed by cement and strengthened considerably, which proved to be a good precaution because after returning to Halifax the port door was found to be considerably sprung by the ice, but not sufficient to cause any leak.

During the following night a field of very heavy arctic ice was encountered and we hove to until daylight not caring to risk entering it.

On July 27 we were off Cape Chidley and though it was very thick we got a glimpse of the Button islands and fixed our position. The ice was fairly heavy, probably arctic ice from Davis strait, but not too closely packed for making headway with caution and two vessels in tow. At 4.30 a.m. the *Burleigh's* tow line was parted by fouling a large pan of ice although the *Minto* was steaming very slowly. We had only one tow line, a 10-inch hawser about 120 fathoms long, and this line was made fast to the *Thomey*. When we took hold of the *Burleigh* a wire cable was used and she paid out about 15 fathoms of chain thus helping to take any sudden strain off the wire. The chain parted near the schooner and it was a very difficult operation hauling in the wire with about 5 fathoms of $\frac{3}{4}$ -inch chain attached to it, and complicated by a heavy roll. The *Burleigh* was brought abreast the *Thomey* and a large pan of ice secured between the vessels to hold them apart. After a delay of three hours the break was repaired and we proceeded on our journey.

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While engaged in this operation the steamer *Beothic*, from St. John's, Newfoundland, and chartered by the Hudson Bay Company to carry Canadian supplies to York Factory and James bay, hove in sight and stood over towards us. She reported that this was the first ice met with and proceeded on her journey, hauling considerably to the north before standing into the strait.

Later in the morning the *Burleigh's* chain parted again but as the break was only a short distance from the wire it caused a delay of about thirty minutes. Many large bergs were seen, but after passing the entrance to the strait we had it fairly clear for some hours.

At 4 a.m., on July 28, when about thirty miles off Savage island, we entered another flow of arctic ice, probably from Gabriel strait. Although the ice was very heavy and closely packed the field was narrow and we pushed slowly through without much difficulty. On clearing this ice the speed was increased to about eight knots until noon when ice was again met with, about thirty miles off Icy cove.

On this occasion also it proved to be arctic ice, some very large pans closely packed together in places. Fair leads could be picked out from the masthead but there was no clear water visible. All went well for some time as we pushed our way through very slowly, stopping occasionally to allow the two schooners to clear pans that swung back again into the track made by the steamer.

At about 1.30 p.m. we glanced off a large pan which it was impossible to avoid and the starboard anchor caught tearing away the hawspipe and considerably damaging the plates nearby. With the ship in this condition it was out of the question to proceed further and we hove to, making fast to a large pan as it afforded considerable protection for repairs.

On examination it was found that the hawspipe was completely shattered and must be removed. In this connection I wish to state that the chief engineer and his staff and our excellent gasoline engineer, Whelan, deserve credit for the manner in which the damage was repaired. We had very little material on hand, an old iron door being used for a patch. The most was made of everything available and a first-class piece of work done. We further strengthened the bows on the inside with concrete and timbers to avoid any chance of future trouble in this quarter.

At this time the *Thomey* was reported to be damaged and making water fast. The fore foot had been carried away by ice. The *Burleigh* towing astern of her caused her to steer badly and made it very difficult to avoid stray pieces of ice. The schooner was brought alongside and cleared of water by steam pumps. A spare fore sail was then stretched under the bow and drawn up as tightly as possible on either side when quantities of ashes were thrown into the sail from the *Minto* and the suction produced by the leak almost stopped it in a few hours. This was most satisfactory as the situation began to look serious.

In the evening we parted company with the *Burleigh* having transferred the missionaries to her, the Rev. Mr. Peck and Mr. Broughton, bound for Lake Harbour, in Baffin Land, about forty miles distant. It was very fine and calm and the ice appeared very light and open towards the shore as far as could be seen from the crow's nest.

We were fortunate in having fine weather for our repairs; the thermometer stood at 26 F. at 7 a.m. on Sunday, July 30, the rigging being covered with a heavy coating of ice. The engineers were working all day at repairs. By noon observations it was found that the ship had drifted about thirteen miles to the northwest in twenty-four hours, and we were surrounded again by arctic ice, some very large pans, in fact small icebergs.

On Monday, July 31, the wind was south, frosty and cool with heavy ice drifting past. The crews were engaged in trimming coal aft to bring the ship up as much as possible forward and therefore in better shape for the ice.

Repairs being almost completed steam was taken at 3 p.m. From the crow's nest,

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as the ice appeared very light towards the southwest, we held in that direction making clear water in a short time and stood over for Wakeham bay. The weather was foggy but we managed to pick up Wales island which is high and bald and easily distinguishable, at 2.45 on the following morning, arriving off Wakeham bay an hour later.

Wakeham bay is well marked by a rather remarkable cliff almost perpendicular and about 1,000 feet high forming the eastern entrance point, whilst the west side has a similar steep cliff but hardly so prominent.

In making the entrance we left two small rocks that lie about two miles off shore, dry at half tide, about $\frac{1}{4}$ mile to starboard and stood in until the entrance, which is not visible from outside, opened up. We entered in about mid channel in which was a depth of over 20 fathoms. The bay is about half a mile in width at the entrance increasing to three or four miles inside and extending in some miles into an inner bay. Good anchorage was found in 17 fathoms over mud bottom off Revillon Frères fur trading post and about one mile off shore. The bay affords good shelter both from wind and sea as it is surrounded by hills of from 500 to 1,000 feet in height. Good fresh water can be procured by boats from some streams.

Mr. Derome, the officer in charge of Revillon Frères post, reported that the season was three weeks at least backward and that the fur trade was very light during the past winter. He expected the company's boat in a month's time. We met our first Eskimo here, two of them came to meet us in kayaks while entering the harbour. I was informed that no Eskimo live here permanently, they only come for the purpose of trading and then leave to procure more furs.

We landed before breakfast and were lucky in finding a suitable place to beach the *Thomey*. It was important to have a place selected, marked by ranges and all the boulders removed before flood tide that no time would be lost in placing the schooner. Early in the afternoon the *Thomey* was beached and later in the afternoon on examination the cut water or lower part of the stern was found badly damaged, and by cutting away the splinters it developed that the stem had been split by bolts driven from the inside while building, causing a leak that could never be located. The damage was repaired as well as possible with the material and tools available and she was found in fair condition when floated.

August 2nd, being a very fine morning, we took an observation of the sun for time, but the sky clouded over by noon preventing further work. We cleared Wakeham bay at 6.30 p.m., the weather being very thick but calm and no ice in sight.

On the following day it was raining and thick light fields of ice were met with off Charles Island, after passing which we hauled in for the south shore of the strait making it about Sugluk and coasted along about half a mile off where a fair passage was found. Occasionally heavy ice was met with, but farther off shore heavy and closely packed fields could be seen. Diggs island was passed at 8 p.m. and about midnight we ran into a field of arctic ice between Diggs and Mansel islands which had come down from Fox channel. The weather was very thick and the ice closely packed so we made fast to a large pan as it was impossible to pick out any leads through which we might make a safe passage.

On August 4th the fog was very dense and we were hove to all day not considering it safe to make a move under the conditions, however a little before sundown steam was taken on the chance of the fog lifting. I often noticed that the weather which would be thick all day would lift suddenly at sundown and finally close in again a little later. On this occasion that took place and being ready we made good headway and were lucky enough to completely clear the ice before the fog closed in again. This was the last ice met with for which I was very thankful and we arrived at Port Churchill at 8 a.m. on the 7th.

While crossing Hudson bay the weather was fine but foggy. The magnetic variation in this locality changes so rapidly that we were obliged to alter the ship's

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heading one degree per hour to hold the course. Our standard compass, which had been placed on board where it would be least affected and therefore require little adjustment, was a great comfort. It was hardly affected by the comparatively close proximity of the magnetic pole and proved very efficient.

When about fifteen miles off Port Churchill the place was easily recognized from the Royal Northwest Mounted Police barracks which, painted white, showed up well and a little later Eskimo beacon was sighted.

Churchill is easy of approach as good water will be found fairly close in. On entering the *Minto* held too much to the westward and as the tide was on the ebb she took a sheer when abreast of the Prince of Wales and rubbed the bottom two or three times but with no serious results. We came to anchor in 30 feet water over sand bottom about three quarters of a mile off shore abreast the sight of the old Battery beacon.

We were very cordially received by Major Starnes, officer in charge of the Royal Northwest Mounted Police, and Mrs. Starnes, who have very comfortable quarters at the barracks. Major Starnes reported that the weather had been very bad and unsettled so far this season and that a large snow bank lay near by until the middle of July.

During the day the beacon brought up to replace the old Battery beacon was landed near the original sight of the latter on the east side of the harbour. Major Starnes took charge of it and agreed to have it erected by his men as opportunity offered, the men's time for the work performed to be charged against the Department of Marine.

The survey stores left in charge of the Mounted Police in January, 1910, were taken on board, the large launch being placed on the main deck forward and securely lashed. Major Starnes very kindly allowed us the use of his launch to facilitate matters.

On August 9th there was a full gale from the west accompanied by rain. We did not venture out considering it wiser to await more favourable opportunity for a first introduction to Port Nelson. The following morning we left Port Churchill with the schooner *Chrissie C. Thomey* in tow arriving off Port Nelson at 7 a.m. next day, August 11th.

On leaving Port Churchill steamer *Minto* held N. 15 E. for eleven miles to clear the shoals making out from the north side of Cape Churchill thence E. by N. for thirty miles before shaping course for Nelson giving Cape Churchill a berth of ten miles and apparently clearing Nelson shoal by over fifteen miles. The weather was overcast but fine and clear. At about 4 a.m. the submarine sentry set at 15 fathoms struck the bottom and on sounding 12 fathoms was found. The speed was reduced and a little later finding 9 fathoms of water we hauled off considerably before coming back on our course and passing about 5 miles off Nelson shoal. This would seem to indicate that the coast along here is apparently charted some miles too far to the westward, and on this account great caution should be exercised to make good use of the lead when using the present chart.

When Cape Tatnam was picked up we were heading about 10 miles inside its extreme. Our course was steered until about 5 miles off the cape then changed to southwest into Nelson roads. The beacon on Marsh point was picked up when at a distance of about 15 miles and a little later the *Minto* came to in 5 fathoms with the beacon bearing S.S.W., distant 6 miles, but as the tide was found to be falling this was considered too shallow and a move of a couple of miles was made.

During the period August 11 to September 7 surveying operations were carried on in this locality with varying success.

We left Nelson on the latter date for a fresh supply of coal at Churchill, after which, on September 21, we returned to Nelson. Operations having to be carried on

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many miles off shore with no protection from any wind it was found most difficult to accomplish much. It is reported that after September 15, the weather is very broken with frequent heavy winds and snow squalls. The agent at York Factory reports that a heavy swell from the eastward always prevails during the autumn and this was our experience making it impossible to land except many miles inside Nelson roads.

On the morning of September 28 there was a heavy swell from the east, the sky was overcast and threatening, and as only a sufficient supply of coal remained to ensure a safe passage to Sydney, we decided to say goodbye to Nelson for the season. Although the *Minto* was rolling considerably no difficulty was experienced in lifting the buoys which had been placed for surveying operations, but for the large launch it required very careful handling of the vessel. About 2 p.m., everything being secured, we squared away for Hudson straits.

On the trip across Hudson bay head winds and heavy seas were encountered and we were obliged to run at a very slow rate of speed as the *Minto* was trimmed by the head by the extra supply of coal carried, which had necessarily been all placed forward of amid ships. Frequently heavy seas broke over the bridge deck endangering the launch on the main deck forward. We arrived off Diggs island in the western entrance to Hudson straits on Sunday morning, October 1. On the passage frequent snow squalls were the order of the day, but no ice was met with although we passed south of a large field off the south side of Coates island.

The fore peak of the *Minto* leaked so badly that the crew were transferred to the second class quarters aft. Probably the deck forward was considerably sprung and opened up while riding at anchor during the last period at Nelson.

The shore from Diggs islands to the eastward is bold and apparently has good water close in. We coasted along at about one mile distant from shore through frequent snow squalls.

We arrived off Sugluk at 3 p.m. and came to about ten miles up the bay late in the afternoon in 14 fathoms of water over clay bottom.

Sugluk harbour is on the south shore of Hudson strait and about midway between Diggs island and Cape Weggs. It is easily recognized by a considerable depression in the coast with an island in the middle of it, which in this locality is made up of a succession of high bluffs. On the southeast side of the entrance will be seen a steep cliff about 500 feet high and when closer in a large rock will be seen perched on the edge of the cliff.

The harbour is a long indentation one mile wide at the entrance and running in a southwesterly direction a distance of about 13 miles with a width of from $1\frac{1}{2}$ to 2 miles. A bar over which 8 fathoms may be carried extends across the mouth and inside a depth of from 50 to 60 fathoms will be found. There is limited anchorage behind the island in the mouth in from 10 to 15 fathoms over mud bottom, but possibly considerable swell enters during a northeasterly gale.

Good anchorage and shelter is available about one mile east of Black point, a prominent dark point about 4 miles inside the entrance in from 15 to 20 fathoms over mud bottom. Northeast of Black point the shore is lined with boulders at low water but in places they do not extend out very far and a small dock for landing coal could easily be arranged. Anchorage can also be had in 15 fathoms with mud bottom about ten miles up the bay abreast a steep rocky cliff with a low gravel bank at the water edge. Care should be taken not to shoal to less than 12 fathoms as beyond this the bottom comes up very rapidly to a boulder bar that extends across the harbour with 3 feet least water over it at low water. Beyond this bar the bay extends a further 3 miles with a width of two miles and a depth in the middle of 30 fathoms.

Fresh water can be obtained in many parts of the bay and at Black point it will be found running off the face of the rock cliff where a vessel can tie up.

During the period spent in Sugluk harbour the weather was very unsettled, heavy winds from the northeast and frequent snow squalls being the order of the day. The

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thermometer registered 24 F. in the early mornings and about 27 F. to 30 F. at noon. A sketch survey of the harbour was made and many soundings taken.

On the morning of October 5 the weather appeared to have made a change for the better, the sun actually came out for some time. The morning was spent finishing up the survey of the harbour and taking on fresh water, and observations of the sun were taken for time and latitude at Black point. Sugluk harbour was cleared at 2 p.m. and though fine and clear inside it was very thick and disagreeable outside.

The weather cleared shortly before sundown and we were enabled to cut in the east end of Charles island also Cape Weggs. The distance between the above points was found to be 10 miles instead of 30 miles as shown on the chart, and Cape Weggs is charted many miles too far to the southeast. No indication of King or Joy island was found. When abreast of the east end of Charles island departure was taken for Big island course S. 35 E. The night was fine and calm though overcast and it was possible to see a distance of some miles. At daylight it was found that the current had swept us some distance out of our course to the southward and we were obliged to haul up S. 58 E. for the entrance to Lake Harbour which is just east of Big island, where we arrived at 10.30 a.m.

Word had been received while we were at Churchill from the Rev. Mr. Peck that the missionaries at Lake Harbour were without supplies and would likely perish during the winter if not assisted or taken home. When about ten miles off the entrance to the harbour the whaler *Acture* from Dundee, Scotland, and under the command of Capt. Murray was met with having just left Lake Harbour. He reported that provisions had arrived in due time for the missionaries, that they were well supplied for the winter, and that therefore no assistance was necessary. Capt. Murray was homeward bound and expected to make Dundee in three weeks' time. He had a cargo of whalebone and walrus hides, valued at about \$20,000.

This was an ideal day, calm and warm, though it was October 6, too good for this time of year as it proved. During the afternoon the weather grew very threatening and next morning we had easterly winds, snow squalls and fog, which continued for some days. The ship's position was fixed by noon observations off Lake Harbour and it was found that the coast line to the eastward or about halfway between Icy cove and Icy cape was charted about five miles too far north, and we were obliged to stand out of the bay some distance before shaping course for Port Burwell. Occasional icebergs were passed, one very large berg about one-half mile square, 75 feet high, off Lake Harbour.

October 7 was a very disagreeable day, southeasterly winds, very thick and frequent snow squalls, 29 F. at 8 a.m. The day was spent drifting about the entrance to the strait trying to get a glimpse of the Button islands. On Sunday, the following morning, the weather was very little better, however, we sighted the Button islands at 9 a.m. and came to in Port Burwell harbour at 3.30 p.m. in 10 fathoms of water over mud bottom.

At present it is difficult to pick up the entrance to Port Burwell but if a proper beacon were erected on the west side of the entrance where a small stone cairn at present stands, it would simplify matters very much. Approaching Port Burwell it is much safer to make the land to the northward, which is bold, and then stand fairly close in until the entrance to the harbour is picked up, but to the southward the shore looks foul and should get a wide berth. Therefore, care should be taken not to pass the entrance when approaching from the northwestward.

The entrance to the harbour is about half a mile wide and although there is a spot with 2 fathoms least water on it a short distance off the west side, a vessel is perfectly safe in mid channel.

On opening the harbour two low diamond-shaped beacons will be seen, the front one built on a low rocky point and the back beacon a short distance to the rear on the side of the steep bank. These beacons in line clear the shoal off the west entrance.

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However, they can be kept open a little to the eastward and come to when the lattice work beacon erected on the west side of the harbour becomes visible from the bow in 16 fathoms of water.

Anchorage can also be found further up the harbour between a peninsula at the north end and a small rock awash at high water, but the space is limited by shoal water that makes out some distance off the peninsula.

Burwell harbour gives good shelter from most winds but it would be uncomfortable in a gale from the southwest. Fresh water can be very easily obtained by boats from a stream in the northeast corner of the harbour.

There is a Moravian mission station behind the peninsula on the northwest corner of the harbour, and several Eskimo families live there. Mr. Simons, the missionary in charge, came on board upon our arrival. He reported that the *Arctic* under Capt. Bernier had been there for a few days about a month previous.

At Burwell we received a supply of ptarmigan and codfish which was very acceptable being the first fresh meat received for many a long day. Strong winds accompanied by snow squalls prevailed, but we sounded out the harbour and took on a supply of fresh water.

The weather appearing to clear and moderate on October 10, we departed at noon, in time to catch the ebb tide which runs about 7 knots per hour through Grey strait.

The northern Button island appears some miles further to the westward than the position given it on the chart.

Cape Chidley is easily recognized when ten or fifteen miles off. It is bold and very high and the land is very hilly in the vicinity; although the Button islands are fairly high and stand well off shore they cannot very well be mistaken.

When clear of Cape Chidley we were very fortunate in finding it fairly calm, wind northeast, which helped us along nicely. Scattered icebergs and an occasional large one, but no field ice, were seen. Indian harbour wireless station was picked up at 7 p.m. on October 11 and arrival reported to Ottawa.

On the evening of the 11th word was received that the coaler *Erik* was in Domino harbour out of coal and requiring assistance. She had left Churchill about September 23. Domino harbour was reached at 11.30 a.m. on October 12 and tied up alongside the *Erik*. A few tons of coal were transferred and we relieved her of a 33-foot launch which she had taken on board at Churchill at my request considering it unsafe to carry both launches on the main deck of the *Minto*.

For the next two days there was a full gale from the north accompanied by snow. The holding ground in Domino proved poor, the *Minto* dragging badly, and we had some difficulty in finding a place in which to take hold.

The *Minto* left Domino on Sunday morning, October 15, making Sydney about midnight on Monday. We left Sydney at noon on Tuesday arriving at Halifax on Wednesday morning.

I have the honour to be, sir,

Your obedient servant,

F. ANDERSON,

Officer in charge Hudson Bay Service.

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REPORT ON HYDROGRAPHIC SURVEYS.

OTTAWA, August 8, 1911.

The DEPUTY MINISTER,
Department of the Naval Service,
Ottawa.

SIR,—I have the honour to present the following report upon the work of the Hydrographic Survey during the fiscal year, 1910-11.

The work has been carried on under the following divisions:—

- | | |
|---------------------------|----------------------|
| 1. Great Lakes. | 5. Lake St. Francis. |
| 2. Atlantic Coast. | 6. Nelson River. |
| 3. Pacific Coast. | 7. Fort Churchill. |
| 4. Lake of Two Mountains. | |

GREAT LAKES.

The work of this survey was as usual conducted from the steamer *Bayfield*, in charge of Captain Frederick Anderson, who was assisted by Messrs. Paul Jobin, E. Ghysens, H. H. Lawson and E. Lapointe. Mr. Bachand was detached for duty in connection with survey work at Fort Churchill, Hudson Bay, and Mr. R. Fraser for work at Nelson River, Hudson Bay.

For the first month the survey was temporarily in charge of Mr. A. G. Bachand, and for the second month under Mr. Jobin, as Captain Anderson was detached for duty of superintending the fitting out of the parties for Hudson Bay.

The steamer fitted out at Prescott, and on May 11, left for the scene of her labours off the south shore of Prince Edward County, Lake Ontario. The shallow inshore water was carefully and systematically examined to a depth of ten fathoms and soundings carried out beyond that to a distance of ten nautical miles or as far out as could be fixed from the shore.

The dangerous shoals off Point Peter, Wicked Point and Scotch Bonnet Island and Presqu'Isle have been for the first time accurately charted. A plan of Presqu'Isle, the western entrance to Murray canal has been made, and should prove valuable to mariners and yachtsmen. The examination of the passages about False Duck and Main Duck islands shows considerable less water than is shown on the existing United States Lakes Survey charts and the soundings taken in the approach to Kingston Harbour also show discrepancies with these charts. It looks therefore as if it will be necessary to re-survey this water in the very near future.

The work from Main Duck island to Presqu'Isle including Presqu'Isle bay, has been concluded and the chart containing the information sent to the engraver for publication. In addition to this the triangulation of the shore from Presqu'Isle to Cobourg was completed and the beacons necessary for sounding erected for work this season.

Captain Anderson reports that during the season the party traversed 60 miles of shore line, sounded 720 miles from boats, and 1,150 miles from the steamer, covering an area of 380 square miles.

On November 7, the steamer was dry docked at Kingston and painted, and on the 11th was laid up at Prescott. Upon the termination of the season Mr. Lapointe resigned.

I am pleased to be again able to report very favourably of the conduct and ability of the sailing master, Wm. McQuade, and the engineers John Nesbit and Wm. Baker, of the steamer.

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After laying up the steamer and at the request of the persons using Alberton Harbour, P.E.I., Capt. Anderson was detailed to make examination of the entrance of that harbour. This he did and reported on December 5.

After this he was sent to report upon a rock in Souris harbour, P.E.I., which he did on January 28, upon his return to Ottawa.

ATLANTIC COAST.

This survey is in charge of Commander I. B. Miles, who was assisted by Messrs. G. C. Venn and Henry Ortiz. Mr. Savary was detached for survey of Fort Churchill, Hudson Bay. Upon the opening of navigation the survey was transferred from the old steamer *La Canadienne* to the new steamer *Cartier*, which arrived at Quebec from the builders, Messrs. Swan, Hunter and Wigham Richardson of Newcastle-on-Tyne on May 6. She is a twin screw steamer of 522 tons register 163 feet long between perpendiculars, 29 feet moulded breadth and 15½ feet deep. She is steel double bottom throughout, has two Scotch boilers with Howden's forced draught and has a speed of about 12 knots. She is equipped with electric light, carbonic dioxide cold storage for meats and vegetables, has gasoline launches and latest style of surveying gigs. So far she has given the greatest satisfaction, is economical of fuel, is a splendid sea boat and furnishes comfortable quarters for officers and crew and for the surveying work. She cost \$176,912.

After docking and the usual cleaning up and painting after the trans-Atlantic trip, the vessel, with party on board, left Quebec on May 31, and spent the season surveying in the vicinity of Rimouski, working out from the point at which work stopped in the autumn of 1910. The river is now charted as far as Bic island and a new chart embracing the water from White island to Bic island will be issued during the season of 1911. The officers and crew of *La Canadienne* were transferred to the *Cartier* and the former laid up for the season at Sorel.

On July 1, Commander Miles left the *Cartier* in charge of Mr. Venn to assume command of the expedition to Hudson Bay and returned August 17, having successfully placed the parties at Fort Churchill and Port Nelson (report on the trip is appended).

The *Cartier* returned to Quebec on November 1, and went immediately into winter quarters. She required very little work upon her. The ship's officers, Capt. McGough and Chief Engineer D. Marcotte, have again shown their usual zeal.

PACIFIC COAST.

This survey is under the command of Captain P. C. Musgrave, who was assisted by Messrs. F. P. V. Cowley, L. H. Davies, C. C. Ross and W. H. Powell, using the steamer *Lillooet* as a base. Mr. Parizeau was detached for survey work at Nelson river, Hudson bay. The party left Victoria on April 5, and reached Prince Rupert on April 10.

A party under Mr. Cowley was immediately placed in camp on Lewis island for the purpose of surveying Arthur passage and Ogden channel, as these waters are well sheltered and the work can be more economically carried out in this way than from a steamer.

Captain Musgrave and the balance of the party were engaged about the north side of Queen Charlotte islands, during the spring and autumn in Masset inlet, and during the fine weather of summer, sounding the eastern end of Dixon entrance, between Rose spit and Celestial reef, or the large area which Captain Parry of the Admiralty Surveying Service was unable to complete in 1908. This was completed, but the western approach to the entrance outside the fringe about three miles wide off North island still remains to be done. Whilst this is supposed to be all deep, there is a reported danger well out and it will be necessary to use up a lot of time in an

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examination of the locality. For this, it is proposed to take the heart of the fine weather of several seasons and have the work done before the trade to Prince Rupert becomes very extensive.

The examination of Masset inlet, Queen Charlotte islands, shows it to be a large lake of about sixty square miles area, connected with Dixon entrance by a narrow channel twenty miles long, but deep enough for any vessel that can cross the bar at the mouth. The lake has many islands and shoals in it, but it can be made very useful. A chart of the inlet is now in the engraver's hands. At the end of the season Messrs. Cowley, Ross and Powell resigned, and were replaced by Messrs. O. Parker and R. L. Fortier.

The officers of the ship, Capt. Griffith, and Messrs. Allen and Borrowman, engineers, gave the work their usual keen attention, thus aiding the surveying staff very materially, and without which progress would not have been very rapid. I regret to add that Mr. Allen, after three years service, accepted better employment and left us in April, 1911.

LAKE OF TWO MOUNTAINS.

This survey was continued and concluded under Mr. A. J. Pinet, assisted by Mr. St. Pierre. For the purpose he was provided with a house-boat and steam launch, and completed the work between St. Anne de Bellevue and Carillon early in August. The chart has been drawn and is now in the hands of the printer for engraving.

LAKE ST. FRANCIS.

Upon the completion of the work in Lake of Two Mountains, the house boat, steam launch and party were transferred to Lake St. Francis at Cornwall, and placed in charge of Mr. C. McGreevy, assisted by Messrs. St. Pierre and Ed. Jodoin, for the purpose of completing the work of surveying the upper end of that lake. This was continued until the end of the season, November 24, when the fleet was laid up in the Cornwall canal. There still remains some examination of suspicious soundings in the lake to be completed in 1911, when the publication of the charts will be placed in the hands of the engraver.

HUDSON BAY.

Owing to the proposal to build a railway from some point in the Canadian Northwest to Hudson bay, this survey was instructed to make an examination of Ports Nelson and Churchill with a view to reporting upon them as desirable termini for railways, or rather whether or not they can be made ports to be used with safety by ocean-going vessels.

For this purpose two parties were organized, one under Mr. A. G. Bachand assisted by Mr. Chas. Savary, both assistants of several years' standing and experience on this survey, to go into camp at Fort Churchill and were provided with the necessary launch and boats for work. The other was under Mr. H. D. Paripeau, assisted by Mr. Robt. Fraser, also assistants of several years' standing and experience on this survey. These officers, on account of the nature of the approach to the harbour, were provided with a three masted schooner, launch and boats. For transporting these parties to the localities the Department of Marine and Fisheries kindly loaned us the ice-breaking steamer *Stanley* which was placed in charge of Commander I. B. Miles. He had as officers Captain Dalton, of the *Stanley*, and Captain S. W. Bartlett, one of the best known pilots for Hudson strait.

He furnishes the following interesting report on the trip, particularly on the ice conditions met with:—

'Ice conditions. Great numbers of icebergs were met with along the Labrador coast. These bergs are reported by fishermen to be much more numerous from the

coast to 20 or 30 miles off than farther out. Probably the best course for a vessel, making from Newfoundland to Cape Chidley, would be about 50 miles off the land.

Cape Chidley was rounded and Gray strait entered at noon on July 18, the ship anchoring in Port Burwell at 3 p.m. the same day.

Port Burwell and the bays along the coast were found to be quite clear of ice, but in Ungava bay, as far as could be seen from aloft, the ice appeared solid. From information obtained from the Mission at Port Burwell, this field has been held in Ungava bay by a long period of light northerly winds. It also appears that this year the ice in Burwell and adjacent bays had broken exceptionally early (about July 10), but as a rule it may be taken that it is impossible to enter these harbours till the last few days of July. In 1909, on the day corresponding to that on which I entered Port Burwell, dog teams were still crossing the harbour on the ice.

On leaving Port Burwell, July 19, heavy field ice was encountered at a distance of about thirty miles. This had apparently set out from Ungava bay and drove the ship a considerable distance north toward Resolution island. The extent of this field was about sixty miles, after which a sheet of comparatively clear water was passed through until 10 p.m. of July 20, when very heavy ice was met with. This kept the ship to the southward and made it necessary to abandon any idea of making Ashe inlet.

In the opinion of Captain Bartlett this was Arctic ice, being much heavier and dirtier than that from Ungava bay.

This pack appeared to be continuous from the northward to within a couple of miles of the southern shore of Hudson strait (Cape Prince of Wales to Digges island), a narrow passage along the shore being apparently kept fairly clear by tidal streams.

After a short spell of clear water off Cape Digges, about forty miles of heavy ice drove the vessel toward Nottingham island.

Mansel island having been passed, the southern point of Coats island was steered for and course set for Churchill.

Towards evening on July 22, the ship struck the outer edge of the largest ice field met with on the whole voyage. This for a distance of about 200 miles, was continuous. This ice was not very heavy for a vessel specially constructed, but called for considerable skill on the part of Capt. Bartlett, the ice pilot, in finding leads.

There being no indication of clear water on either side it was resolved to make as direct a course as possible. The ship was seldom stopped, but was heavily shaken by the continuous pounding necessary to force her way through.

This field was suddenly cleared on the morning of July 24, and Churchill was reached the same night without further delay.

Churchill and Nelson having been visited, the vessel left the latter place on the evening of July 30, on the homeward voyage. Within a few hours of leaving Nelson the heaviest ice yet met was encountered, and for about ninety miles very slow headway was made. This having been cleared, nothing but light ice was met, either in the bay or strait, until after leaving Port Burwell. Whilst at anchor at Port Burwell awaiting the arrival of the *Earl Grey*, the ice set out of Ungava bay before a moderate southerly breeze, and Burwell harbour was completely filled. The ice was, of course, loose but made boat work impossible at times.

Port Burwell was left upon August 9, and within an hour the ship for the first time encountered ice that stopped her. This had evidently been heavily packed in slack water, the flood carrying its own ice to meet that returning through Gray straits on the ebb. When the strength of the tide made itself felt, the ice holding the ship was loosened and by keeping close along the southern shore of Gray strait, Cape Chidley was rounded and course set for southward. The pack was apparently very heavy up to the Button islands.

Very few bergs were seen on the return along the Labrador coast.

Whilst numerous bergs were met with in the eastern part of Hudson strait, none were seen in Hudson bay itself, and Capt Bartlett informed me they are practically unknown there.

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It would appear from the above remarks that vessels may expect to meet ice from Cape Chidley to Churchill, but Capt. Bartlett's opinion was to the effect that our experience was exceptional, and that a long spell of light winds had contributed to the packing of the ice. Personally, I cannot see why this should be so, as the ice forms and breaks away year by year, some years (as the present, 1910) exceptionally early, no doubt, but it must be met some time during the navigation season. Long spells of wind in one direction might hold it in the bays and inlets for some time, but it is not likely that these winds would be so continuous as to keep it there until frozen in again. Therefore, any vessel navigating the bay must be prepared to meet ice. Whilst none of that met with on this voyage could have been dangerous to the *Stanley*, or sealers and other specially constructed vessels now trading in the district, I am of the opinion it might be dangerous to a ship not so built. I certainly do not think any cargo vessel of ordinary construction would have been able to find or force her way through the large field met before Churchill, but would have been obliged to remain in the ice until it was loosened by winds or currents.

Under the weather conditions which prevailed whilst the *Stanley* was in the bay, a ship might wait an indefinite period for the ice to open up again. In the event of a strong breeze which would eventually disperse it, the preliminary would be a heavy packing to leeward, which might jeopardize the vessel.

Throughout the above remarks 'ice' is to be taken to mean ice fields and not bergs.

WEATHER CONDITIONS.

The *Stanley* was exceptionally fortunate in weather while in Hudson bay and strait, nothing more than a moderate breeze being experienced. But, as a general rule, in the strait and bay proper, no lasting heavy weather need be anticipated during July and August, although in the vicinity of Nelson river, heavy 'northers' in August are reported by the Hudson Bay vessels, sometimes lasting from 36 to 48 hours.

A considerable amount of fog was met with, which would be expected with the light winds prevailing during the voyage. This fog was usually in the vicinity of ice, but not necessarily so.

Temperatures in the bay and strait were not low, the air averaging between 31° and 40° F., sea water between 30° and 40° F.

Owing to the uniform temperature of the water, little can be judged from this as to the vicinity of ice. This was also noticed after clearing the Straits of Belle Isle, that is to say, that the colder currents having been entered, the proximity of even large bergs made little difference to the temperature of the water.

GENERAL NAVIGATION.

Apart from the ice question which it will be seen is by no means insurmountable, the dangers and difficulties of the navigation of Hudson strait and bay arise chiefly from the inaccuracies of the charted positions of the salient points, and from the proximity of the magnetic pole, with the consequent effect on compasses.

As the whole of the Hudson bay chart appears to be more or less in the nature of a sketch or running survey, great caution would naturally be exercised by the ship masters in making land.

From my experience on this voyage, the land and islands are in some cases fifteen to twenty miles out of longitude. This may be modified when I have reworked the many observations taken, but in any case it would be unwise to attempt to make any land except in daylight and clear weather.

The Button islands, southern shore of Gray strait, and the land between Cape Prince of Wales and Digges island, as shown on chart, bear little resemblance to the

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actual coast. King and Joy islands do not exist, and Charles island lies much closer to the mainland than the chart shows.

I would have endeavoured to run a line of soundings on the outward voyage, but having a schooner in tow, and being so beset by ice, this was impossible. When able to do so on the return from Port Nelson to Cape Digges, I ran an almost continuous line, soundings being taken at intervals of 10 miles in deep water, and 5 miles in shoaler water.

COMPASSES.

As regards the great 'bugbear' of Hudson Bay navigation, the reported local attraction and inaccuracy of the compass, I found nothing to justify this evil reputation. In one or two places only, and when in close proximity to the high land (Cape Chidley and Cape Digges, for instance) I found a deviation of two or three degrees from the normal. Whilst in southern waters, Halifax and Strait of Belle Isle, I had very carefully adjusted the compass of the *Stanley*, which was excellently placed as far as the ship's magnetism was concerned, and had reduced the error due to ship to such small amounts that almost the whole of the compass 'error' found by observation in the bay could be accepted as due to variation, as opposed to deviation.

Being exceptionally fortunate in having clear sun and stars, my observations for error were almost hourly, and showed that the change of variation, though rapid, was normal, but the lines of variations will not quite agree with those shown on Admiralty charts. For instance, the line of 'no variation' lies about 30 miles east of that shown on chart. As stated above the proximity of the magnetic pole (and consequent small value of horizontal force) renders the needle sluggish and an alteration of a few degrees in direction of the ship's course is not immediately shown by the compass.

As the chart stands at present, continuous observations for compass errors are necessary. This is only in accordance with the ordinary practice of seamen, and I think that when the lines of equal variation have been correctly charted (and positions rectified) no more difficulty will be found in the navigation by account than is experienced in the approaches to the Gulf of St. Lawrence, where the rapid change of variation necessitates hourly alterations of the course.

It may be remarked that a liquid compass was found to be almost useless, especially in the western portion of the bay.

TIDES AND CURRENTS:

As far as could be observed from the high water marks along the coasts passed, the H. W. F. & C., was much as shown on chart. The many deviations from the course, made necessary to avoid ice, prevented any reliable data being obtained as to the set of the currents, except that, as would be expected, a strong tidal set was felt in and out of the bays and indentations of the coast. In Gray strait the Spring tides are so strong that it is advisable to time the approach to pick up a favouring stream.

PORTS NELSON AND CHURCHILL.

Until the results of the detailed surveys are in, it is difficult to give an unprejudiced opinion as to the relative values of Fort Churchill and Port Nelson as ports, and I can only take the point of view of a master of a vessel making these places for the first time without local knowledge or pilot's assistance.

When making Port Churchill, having obtained good sights for latitude and longitude at 5 p.m. and later picking up soundings, I proceeded until 11 p.m. when the distance being run down, I hauled to the southward for the port. Fog came down

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and I anchored for the night. When the weather cleared about 10 a.m. the following day, the beacon at the entrance to Churchill harbour was seen, the harbour easily entered and a comfortable anchorage picked up.

I give this detail to show the facility with which the port can be made.

Churchill harbour, although of not very great extent as it at present stands, appears to me to be adapted to easy enlargement, the eastern shore having good water close to. The entrance is narrow and I do not imagine any sea could get up that would inconvenience loading operations alongside wharfs, but the heavy tide and current from the Churchill river running against a strong breeze makes boat work difficult at times.

The land in the vicinity of Cape Churchill is rocky with stunted trees, the highest part of this land being about 100 feet above H. W.

The dangers shown on Admiralty chart No. 863 as being off Cape Churchill are locally stated to be much nearer the land.

Having left Churchill on July 27, I proceeded to Nelson roads.

The land in the vicinity of Cape Tatnam and the western shore is very low, the summit of the trees being certainly not more than fifty feet above H. W. The ground on the approach to Port Nelson or York roads was found to be very foul.

Four fathoms of water was picked up with no land in sight, and eventually anchored in nine fathoms in a position where the trees were only visible from aloft, and a beacon which is situated near the entrance to Hayes river and the summit of which is 80 feet above H.W., was just visible from the ship at a height of 40 feet above the water. Although only 80 feet high this beacon can be seen some time before any other sign of land is visible.

The day following my arrival, I ran with a launch to Hayes river and found that a drying flat of sand and boulders, extends about three miles from the shore, less than 18 feet of water for a further four miles, and less than 30 feet for an additional three or four miles.

The current from the Nelson and Hayes rivers is very swift, a great volume of water being discharged into Nelson roads. When this current combines with an ebb tide and sets against the heavy northerly gales which prevail here in August and September, a very bad sea is raised, especially, as may be imagined, inside the five fathom line of sounding. The Hudson Bay vessels have found much difficulty in making, and holding, their positions in Nelson roads and on more than one occasion have been obliged, after waiting some days for favourable conditions, to abandon all idea of discharging. They have then carried their cargoes on to Churchill, from whence it had to be drawn by dog teams during the winter. The usual procedure for the Hudson Bay vessels is to close the land as much as possible on the rising tide, and on their signals being observed by officials ashore, to steam out and anchor at a distance of about 18 miles and await the boats.

In August, 1909, one of these vessels experienced a northerly gale of 48 hours duration, during part of which time she was steaming full speed with both anchors down, with a heavy sea breaking on board. After remaining in the vicinity for ten days, and being unable to work, she proceeded to Churchill and there discharged her Nelson cargo.

After leaving Port Nelson anchorage I sounded my way out to the northeast and carried good water for some miles until, at an estimated distance of from 12 to 15 miles from Cape Tatnam, I suddenly picked up 10 fathoms and thought it advisable to haul due north. The ground in the vicinity of Cape Tatnam is reported locally to be as foul as that on the western side of Port Nelson.

As a result of Mr. Bachand's survey at Port Churchill, I beg to offer the following report:—

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'Churchill harbour is situated in latitude 48-56-10 N. and longitude 94-10 W. and about the middle of the west shore of Hudson bay.'

The approach to Churchill harbour is very well marked and comparatively easily picked up. The first landfall (approaching from Hudson strait) is Cape Churchill, which stands well out from the low west shore and contrast to the shore south of it, may be approached to within a comparatively short distance. From this Cape to the Harbour is a distance of 35 miles and a vessel may keep close enough to have the shore in full view until Eskimo Point and beacon at the entrance are made out.

This clear approach is important and in marked contrast to the approach to the whole shore from near Cape Churchill to James bay, which is fronted by a shallow band many miles wide.

The entrance to Churchill between the 18 foot contours is 1,100 feet wide and has as much as 90 feet of water in it with not less than 6 fathoms outside.

The harbour itself is in two parts, outer and inner, but the latter is so shallow as to be useless and injurious to the former, in that it furnishes a large area in which water is stored during flood tide to cause strong currents through the entrance at ebb tide.

The outer harbour or harbour proper is about 3,000 yards long north and south with an average width of 2,000 yards giving an area of one and a half square miles most of which, however, is very shallow. The area of water over 18 feet deep inside the entrance is about 1,600,000 square yards or about half of a square mile. The anchorage space is therefore not suitable for more than three or four vessels.

The east shore of the harbour is a long narrow point not over 40 feet high tapering from 3,000 feet at the inner and to a small rock at the entrance. For a distance of 6,000 feet from the entrance this point is fronted by a shallow band and a lane of water 700 feet wide over eighteen feet deep. If this harbour should be selected this would give an excellent site for sufficient slips and piers for a large traffic.

The west shore of the harbour is another point about 8,000 feet wide and terminating in a small island and the remains of old Fort Prince of Wales. This point is not considered so suitable for wharfs, piers and ships or railway yards.

Not being provided with the necessary apparatus, no borings of the bottom were taken, but as far as observed it is silt from the river.

TIDES.

The range of the spring tides is about 15 feet and the water rushes through this entrance with a velocity of 6 miles per hour on the ebb tide and $2\frac{1}{2}$ miles per hour on the flood. As remarked in the beginning of this report the inner harbour is very large and allows a large volume of water to be impounded furnishing a supply that must escape during the ebb and cause heavy currents. The harbours might be separated by a dyke and thus provide a wet basin above and cut off the supply for the strong currents at ebb tide.

SHELTER.

The entrance being narrow, no sea of any consequence can come in, but when northerly to northeasterly gales blow, some sea strikes the west shore for a short distance inside the entrance and creates an uncomfortable condition for vessels anchoring off the R.N.W.M.P. post, particularly with the ebb tide. A vessel anchoring closer under the eastern shore experiences little inconvenience from sea or tide, and in the situation suggested for the wharfs and piers a vessel would suffer none. The high winds will, of course, be felt as the shores are comparatively low and void of trees.

ICE.

In 1910 floating ice first appeared from the river on October 15, and the harbour was closed on December 5. The survey party reached Churchill on July 25, and

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no ice was seen afterwards; first snow appeared on September 9, but the season was reported to be an unusually short one.

As a result of Mr. Parizeau's survey at Nelson river I beg to offer the following report:—

Port Nelson is situated approximately in latitude 57-03 north and longitude 92-35 west, or about 120 miles south of Port Churchill.

The work on the survey of Port Nelson was carried on during the season of 1910 from the three-masted schooner *Chrissie G. Thomey*, purchased in Newfoundland especially for the work. It was in command of Mr. H. D. Parizeau, who was assisted by Mr. R. F. Fraser. The crew consisted of Captain Thos. Gushue of Brigus, Newfoundland, and nine men.

Mr. Parizeau and party left Halifax on June 27, under orders to meet the steamer *Stanley* at Port Burwell and be towed to destination. The meeting took place on July 19, and the two vessels reached the outer anchorage off Port Nelson on July 28.

On the trip heavy ice was encountered and the vessels were unable to call at Ashe inlet for magnetic observations as intended. A track was, however, discovered along the south side of Hudson strait close to land and the bay entered on the 22nd. Across the bay heavy ice was found until within 70 miles of Port Churchill, after which no trouble was experienced.

At the present time anchorage is taken up at a great distance from shore. The Hudson Bay Company ships run in as close as possible on the high water to signal the post at York Factory and when seen they leave and anchor about 18 miles from Point Marsh.

Last season when approaching Nelson river to put the schooner on the station for her work, the steamer *Stanley*, with her in tow, ran into shallow water (4 fathoms) then moved out to 9 fathoms and fixed her position as 10 miles from land where nothing could be seen from the deck and only a few trees on the beacon on Marsh Point from the crow's nest.

After becoming acquainted with the locality and procuring a pilot the schooner was piloted at high water to an anchorage just off the position selected for the outer railway wharf.

Owing to the great difficulties encountered very little surveying that can be placed on paper was done. The greatest labour was necessary to get ashore with material for signals and owing to the low beach these had to be large and high that they might be seen a few miles off. The winds and seas were very heavy and in the exposed situation working from even a large well covered-in launch was impossible.

If very little of a definite nature was ascertained, a good deal of information that will be of material assistance next season was obtained.

At a point 15 miles from the beacon on Marsh point and the same distance from Sam's creek, there is a depth of only ten fathoms. The water towards the river gradually shoal and the river channel deepens until at a point midway between Marsh point and Sam's creek, a bar is reached over which not more than 21 feet can be carried. Here the channel at low water is about 600 yards wide, the banks on either side drying at low water. Inside, the channel deepens again and continues for seven miles to the position selected for the outer wharf, where only 17 feet water can be found and the channel is about 600 yards wide.

Observations for tides show that springs rise 16 feet and neap 10 feet, and the tides flow and ebb at from 2 to 3 knots.

Of course, this information is all gathered from cruising about in bad weather, when circumstances made it impossible to fix one's position for transfer to paper and when the survey work is completed it may have a different appearance.

There is one thing certain that the survey is no child's play, the roadstead is exposed to every wind that blows and every sea that runs, the currents and cross currents are strong, the shore so low that nothing can be seen from boats and all locations must be determined from the previously ascertained position of the ship.

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Ice began to form, coming down the river on one tide and up on the next, on October 31, and gradually became worse, each day making navigation more hazardous.

Until further and proper definite information is obtained, no opinion can be expressed as to the suitability of this port for a terminus.

On September 12, it was decided to send the schooner to Halifax and continue the work from camp until the ice would render moving about dangerous.

The schooner therefore sailed, arrived at the western entrance to Hudson strait on the 15th, and at the eastern entrance on the 21st, having experienced strong gales and snow storms and thick weather, almost all the way. Twelve icebergs were seen off Ungava bay. The vessel reached Brigus, Newfoundland, on October 7.

The survey party including Mr. Parizeau and Mr. Fraser remained at camp until January 20, when they left for Winnipeg by dog train and arrived in Ottawa on March 4.

During the year the following new charts have been issued:—

- No. 103.—Copper island to Lamb island.
- “ 98.—Goderich harbour.
- “ 202.—Razada island to White island.
- “ 203.—Approaches to Saguenay river.
- “ 303.—Tree Bluff to Kinahan island.
- “ 21.—Quebec harbour.

A second edition of the following charts was also issued during the year:—

- No. 1.—Montreal to Long Point.
- “ 11.—Three Rivers to Becancour.
- “ 15.—Cape Levrard to St. Emelie.
- “ 16.—St. Emelie to Deschambault.
- “ 101.—Head of Thunder bay to Pigeon river.
- “ 102.—Lamb island to Thunder cape.
- “ 301.—Prince Rupert harbour.
- “ 50.—Lake St. Louis.

I have the honour to be, sir,
Your obedient servant,

WILLIAM J. STEWART,
Hydrographer, Department of the Naval Service.

File No. 4482A—36.

October 25, 1911.

Mr. W. A. BOWDEN,
Chief Engineer,
Department of Railways and Canals,
Ottawa.

DEAR SIR,—I beg to submit the following short summary of this season's operations, the reports from engineers in the field coming to hand a few days ago.

On the portion from The Pas to Thicket portage a party has been working all summer with such good results that the final location distance is now only three-tenths of a mile longer than the theoretical air line distance, with curvature averaging less than one degree per mile, the quantities being reduced to about 10,000 cubic yards per mile, and a considerable reduction in bridging as well. A very marked improvement has also been made in the rise and fall of the grade line. Taken altogether the season's work has probably reduced the cost of this section by \$300,000.

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From Thicket portage a second party has been working on the heavy section from that point to a few miles beyond the Nelson River crossing, a distance of about seventy-five miles. A new preliminary line was run with the object of reducing if possible some of the heavier portion of this work. This has been largely done, and it would seem as though the only work which can be classified as heavy over the whole line will be reduced now to about twenty miles in all.

Further examination of the Churchill route has also been made with the result that the junction point will now be about the 300th mile from The Pas. This new route removes the heavy work and grades from the Churchill route and only increases the distance about fifteen miles.

A more detailed report on this point will follow shortly.

The located distances are now as follows:—Nelson, 415 miles; Churchill, 502 miles.

On the McArthur contract some ten or twelve miles of clearing has been completed, some ditches and drains constructed and a little grading done, the total probably reaching between \$7,000 and \$8,000.

I would be obliged if you would find out as soon as possible what is to be done with the two resident engineers' parties north of The Pas.

Yours truly,

(Sgd.) J. ARMSTRONG,
Chief Engineer.

File No. 4482A—41.

DEPARTMENT OF RAILWAYS AND CANALS,
WINNIPEG, MAN., January 9, 1912.

Hudson Bay Railway.

Mr. W. A. BOWDEN,
Chief Engineer,
Department of Railways and Canals,
Ottawa.

DEAR SIR,—I beg to submit the following resume of the work on the Hudson Bay railway since the general report dated October 31, 1909.

The routes referred to in the above mentioned reports have been worked out in detail with revisions, and other suggested routes as well.

The location may now be said to be completed with the exception of some local revisions, some of which are now under way, and also the proposed line from the neighbourhood of Kettle river to Churchill.

The line proposed along the easterly side of Setting lake and the Grass river waters to rejoin the Churchill line at Big lake about mileage 295 of the Churchill route when run proved somewhat of a disappointment, although some improvement over the original line run on the westerly side of these waters. One of the principal drawbacks we found was the heavy bridging encountered at the crossings of the Grass river, the Burntwood river, and the Narrows of Assean lake, these three crossings totalling approximately \$750,000. On the original line somewhat heavy work was met with between miles 120 and 300. On the new line via Thicket Portage this work was lightened somewhat, and reduced from 180 miles to about 130 miles. While the above work was in progress the work on the Nelson route across the same strip of rough country disclosed a much lighter and shorter piece of heavy work, this line confining the heavy work between miles 170 and 235, a distance of about sixty-five miles, and crossing Nelson river at Manitou rapids. A line was run from this route

towards Churchill designed to join about the 240th mile, crossing Nelson river a second time immediately east of Split lake, where a good crossing of Nelson river was obtained about 1,000 feet in length. The bridging on this route although involving two crossings of Nelson river is estimated to cost about \$500,000 or \$250,000 less than the route to the west of Split lake. The balance of the line has everything in its favour over the western line in curvature, grades, and cost of work. This line has not yet been extended to Churchill, but from reports of Mr. J. B. Tyrrel and other explorers it seems probable this line should be kept further east than the original line along the dotted projection shown on the accompanying map. It seems probable that lighter work will be met with here and grades so much better that they will more than offset the added fifteen or twenty miles of distance.

With a given tonnage to handle the train mileage will probably be less via the long than via the shorter line owing to the greater tonnage which can be handled per train.

The line from Manitou rapids to Port Nelson was found to be very favourable, the grades, curvature and cost will all be very light. The line was run to the eastern side of Port Nelson. An investigation is under way at the present time looking for the most feasible crossing of the Nelson river in case the north side is chosen. A line will be as easily built on the north side of the river as on the south side with the exception of another crossing of Nelson river and a crossing of Limestone river. It is expected that a report may be made on this portion of the line before the end of March coming. From this crossing of Nelson river at Kettle river a projection has been made to Churchill, but is only to be used in case Port Nelson is chosen as the terminus now, and some years hence a desire to also utilize Churchill may best be served by turning off the Nelson route at the point indicated. In case Churchill is chosen now undoubtedly the line to follow is the one crossing the Nelson river just east of Split lake.

The portion of the line located between The Pas and mile 120 has proven the most difficult portion to give a decisive opinion upon as to the best location. Work on this portion has been continuous and though considerable improvements have been made from time to time they have been entirely of a local nature. I do not think the final location in any place is a mile from the first preliminary line.

In July 1910, Mr. T. Turnbull was engaged to take a trip to Port Nelson particularly to look into the most suitable site for the proposed town. His report indicates that the north site is the better from a landscape point of view but that from a utility standpoint there is practically no difference. The question to be settled is whether the extra cost of harbour works on the south side is as great or greater than the extra cost to the railway of crossing the Nelson and Limestone rivers to reach the north side. As noted above, information as to this will be available before the end of March.

As to railway terminals, the ground on either side is well suited for such works, both as to area available and situation with regard to docks, &c.

Terminal room can be had at Port Nelson for all the roads in Canada if necessary.

At Port Churchill the room for terminals at all convenient to possible dock sites is not satisfactory. The west side of the harbour is entirely out of the question and the area on the east side very inadequate if any considerable development is required.

The location as it stands at present leaves the distance to Port Nelson as 418 miles and to Port Churchill *via* the east side of Split lake as 498 miles. It is altogether likely that further changes or revisions may be made from time to time, but will be entirely of a local nature and will not materially affect these distances.

The theoretical air line distance from the Pas to Port Nelson is 412 miles and the chained location distance 418 or 1.5% over the air line.

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Comparison of routes.

For the purpose of the comparison of routes it is assumed that traffic for 3,000 trains per year will eventually develop, divided into 1,800 trains running towards the bay and assuming a lighter tonnage from the bay the trains have been set at 1,200 making the total of 3,000 trains. The above assumes grades of four-tenths of one per cent both ways. On the first line to Churchill it was found necessary to adopt six-tenths grades against south bound traffic in order to get reasonable work over the 150 miles division next to Churchill, thus reducing the tonnage per train by about one-third, converting the south bound 1,200 trains into 1,600 or an additional 400 trains over 150 miles equal to 60,000 extra train miles per year. On the route via the east side of Split lake the whole 3,000 trains will have to pass over 20 additional miles equal to 60,000 train miles per year leaving the two lines equal as far as train mileage is concerned, but leaving in favour of the eastern route a cheaper line to construct and the generally more satisfactory operating conditions over a line with easier gradients.

Comparing the Churchill route and the Nelson route it can now be taken that grades, curvature and cost of construction per mile will be approximately the same over both routes, and need not be taken into consideration, leaving the question of distance the only one to be considered.

In the report of 1909 attention was called to the problem of building across the 75 miles of tundra into Churchill and the probable difficulty that will be met with during the winter months with snow. No engineers have yet been met with who have had sufficient experience with this class of material to be able to give a reliable opinion on this question, such advice as has been tendered has been given by those who have no knowledge of the subject whatever. Some engineers have been met with who have had experience with very short stretches of similar material and its behaviour was precisely as feared. While short stretches of 1,000 feet or even a mile may be overcome easily, a continuous stretch of 75 miles is a more difficult problem.

The additional distance of eighty miles to Churchill is sufficiently great to make it necessary to add another train division to the line thus directly affecting all the items which go to make up the cost of running a train a mile, viz: track maintenance, repairs to rolling stock, train wages, fuel, cost of maintaining and operating terminals, structure, etc., hence it will be necessary in comparing the routes to use the full cost per train mile which would not be necessary if the distance were small enough to be measured in feet or a very few miles.

In the following comparison the cost per train mile used is \$1.75 made up of cost of operation put at about \$1.30 per train per mile, a charge lower than given by either the Department of Railways and Canals or the Interstate Commerce Commission. To this has been added 45 cents per train mile to include the interest on the cost of construction of equipment. In other words for every train run a mile over the road \$1.75 will have to be collected from the public in order to pay all charges. The annual statement of the Canadian Northern Railway issued in December, 1910, gives the operating expenses per freight train mile as \$1.50 to which has to be added fixed charges which will make their total charge more than \$1.75. The gross earnings per freight train mile are given as \$2.59 and for all trains slightly over \$2 per train mile. In other words for every train the Canadian Northern ran a mile, more than \$2 was collected from the public and in the case of freight \$2.59. The figures for the Canadian Pacific Railway and other roads are not at hand just now but are now very much different from the above.

Thus you will see that if expenses are held to \$1.75 per train mile it probably means the lowest rates in Canada to the public.

On the basis of 3,000 trains per year the following then appears to be the minimum which it will be necessary to collect from the public:—

CHURCHILL ROUTE.

| | | | |
|------------|---------|--------------|------------------------|
| Distance. | Trains. | Train Miles. | \$1.75 per train mile. |
| 500 miles. | 3,000 | 1,500,000 | 2,625,000 |

NELSON ROUTE.

| | | | |
|------------|-------|-----------|-----------|
| 420 miles. | 3,000 | 1,260,000 | 2,205,000 |
|------------|-------|-----------|-----------|

In favour of Nelson route... .. \$ 420,000

From the railway end of the problem it is apparent that a minimum of \$420,000 per year will be saved to Western Canada by the selection of Port Nelson as a terminus. If the charge of \$1.75 per train mile is found too low or the traffic is greater than 3,000 trains per year the difference in favour of the Nelson route will be found still greater.

Another way to illustrate is as follows:—

| | |
|---|-------------|
| Cost of operating railway to Churchill per year | \$2,625,000 |
| Assume cost of terminal development at \$10,000,000 at 4% | 400,000 |
| <hr/> | |
| Total cost of the route to the public per year.. .. | \$3,025,000 |
| Cost of operating railway to Nelson per year.. .. | \$2,205,000 |
| Assume cost of terminal development at \$20,000,000 at 4% | 800,000 |
| <hr/> | |
| Total cost to the public per year.. .. | \$3,005,000 |

I do not know what the final results of the Naval Service investigation of Port Nelson shows, but they must have found a very bad place if the above figures are overcome.

(Signed) JOHN ARMSTRONG.

DEPARTMENT OF RAILWAYS AND CANALS,
HUDSON BAY RAILWAY.
WINNIPEG, MAN., January 23, 1912.

Mr. W. A. BOWDEN,
Chief Engineer,
Department of Railways and Canals,
Ottawa.

DEAR SIR,—I am presenting herewith for your consideration a few of the points in connection with the selection of a terminus for the Hudson Bay Railway.

At the present time the three provinces of Manitoba, Saskatchewan and Alberta are exporting about 150,000,000 bushels of grain, besides other products. The three present railway systems are taxed to their utmost to prevent congestion during the season when these 150,000,000 bushels are being moved, and in spite of their efforts many local cases of congestion still occur. It is variously estimated that when the available area of these three provinces are brought under cultivation there will be a crop of from 600,000,000 to 800,000,000 bushels, thus making it necessary to further enlarge the capacity of the present transportation systems and provide other new ones.

The Hudson Bay Railway route is one of these new outlets for western produce and in order to fulfill the object of this route so that the greatest possible benefits may

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be had from it a careful consideration must be given to the terminus at the bay as well as to the railway portion of the route.

The greater portion of the traffic over this route will be of a low grade, consisting largely of agricultural products exported, and coal and manufactured products imported; a traffic producing a large tonnage but requiring the lowest possible freight charges against it.

Another object is the local development of the country passed through, and the development of the resources of the bay itself, requiring the route to pass through the country most susceptible of improvement and the selection of a port which will give the longest possible season to carry on development operations. Under the most favorable conditions this season will be short and the port should be chosen with a view to taking advantage of every possible day available.

A further consideration must also be given to an alternative route via James bay to Quebec, the following figures being of interest relating to this route:—

| | Rail. | Water. | |
|---|-------|--------|----------------|
| Saskatoon to Port Nelson.. | 650 | | |
| Port Nelson to Hannah Bay.. | | 750 | |
| Hannah Bay to Quebec City via Quebec & Lake St. John Railway.. | 550 | | |
| | <hr/> | | |
| Total.. | 1,200 | 750 | = 1,950 miles. |
| | | | |
| Saskatoon to Fort William.. | 900 | | |
| Fort William to Parry Sound.. | | 500 | |
| Parry Sound to Montreal.. | 380 | | |
| Montreal to Quebec.. | | 180 | |
| | <hr/> | | |
| Total.. | 1,280 | 680 | = 1,960 miles. |

This route from Saskatoon via Hudson bay to Quebec city is open probably quite as long as the Great Lakes route, provided the port selected is available for that length of time. The rail haul on this route may be further shortened if Chicoutimi may be used as a terminal.

The term ‘Port’ usually includes roadsteads, entrance channels, harbours, docks, accommodation for railway terminals, and equipment for the exchange of freight between rail and water.

The term ‘Harbour’ signifies only a place of shelter for shipping without any terminal development, and it is only one of the many points to be considered when discussing the port or terminus. Natural harbours are sometimes found but natural railway terminals, docks, port equipment &c., never. By far the greater portion of all great ports is artificial.

In considering the cost of water transportation as compared with land transportation the following rule has been given: That it will cost as much to carry 50 tons by vehicle as 500 tons by rail or 5,000 tons by steamship. It will be seen, therefore, that one of the principle objects to obtain is a port as near as possible to the centre of business.

The ports of Antwerp, Hamburg, London, Liverpool and Glasgow are examples of the influence of geographical position upon the success of a port. None of these ports owe their success to natural harbours but to their convenient situation for the collection and distribution of freight.

Coming nearer home we find Halifax with one of the finest natural harbours in the world unable to compete with the geographical position of Montreal. Although it took many millions of dollars to do it, it was found advantageous to come to Montreal and pass the much finer natural harbour of Quebec only 180 miles away.

Briefly stated the problem is as follows: The Hudson Bay railway traffic will be made up largely of a great volume of heavy or bulky freight, the chief consideration in the handling of which is an economic port fitted with freight handling devices that will enable a large quantity of freight to be handled in the least possible time, large storage areas for the collection of this freight as near as possible to the ship's side, and with the best possible railway communication to the centres of production and consumption, calling for the best possible grades, distance and ease of operation, and, in order to get the best possible out of local development, a port open to navigation as long as possible.

An examination of the western coast of Hudson bay shows only two possible places that can be developed along these lines, viz.: Port Churchill and Port Nelson, other possible ports being eliminated from consideration owing to the long rail haul to reach them.

Port Churchill is situated at the mouth of Churchill river in latitude 59° approximately. The area available for townsite and railway development was found to be very inadequate. The western side of the lagoon is practically impossible to railway development and the area on the eastern side very restricted.

At the present time the area required for terminals used at Fort William and Port Arthur is about 650 acres. Such an area cannot be had except at very great expense at Port Churchill in less than three or four miles from the present harbour. The most suitable area for railway terminals is situated about six miles from where any possible harbour development could be undertaken at the present time.

The most direct rail route from The Pas to Churchill gives a distance of 477 miles but involves considerable heavy construction work, heavy curvature and unsuitable grades. A more satisfactory line has been found further east greatly improving the cost of construction, the curvature and the grades, although increasing the distance to 500 miles.

Port Churchill has often been spoken of as a fine natural harbour. This may be true for a very limited number of ships, two or three, but keeping in view of the object of this route it may be said to be no harbour but rather a breakwater. The basin in which ships could ride in shelter behind this breakwater would practically all have to be dredged out, and every indication is that this would have to be done in solid rock.

The water at the entrance to the harbour is very deep and allows the full strength of the ocean swells to enter, thereby creating a surge throughout the harbour which may somewhat inconvenience a ship loading at a dock.

At ebb tides the currents are very strong, rendering it impossible for anything but strong powered ships to enter the harbour. This strong current also creates a serious condition of affairs when the harbour is full of ice. When the heavy ice begins to break up in the spring and commences to run back and forth in the harbour at the rate of six or eight miles per hour it is evident some extra substantial form of construction will be necessary to withstand this.

It is also reported on good authority that Churchill harbour is sometimes blocked by Arctic ice for a period during the summer.

The Hudson Bay railway party stationed at Churchill during the winter of 1908-9 found that although the harbour was cleared of ice in June the pack remained close off shore until July 15, preventing their return to Nelson until that date.

Local development will largely be carried on by sailing ships and small steamers which during the summer of 1909 at any rate could not have begun operations before July 15.

The following table showing the opening and closing of navigation at Churchill is by Mr. J. B. Tyrrell and published by the Geological Department in 1897.

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| — | Open. | Closed. | Length of Season. |
|--------------------------|--------------------|--------------------------------|---------------------------|
| Average | June 19 | Nov. 18. | 5 months. |
| Earliest | " 5, 1863. | " 1, 1837. | |
| Latest | " 2, 1866. | Dec. 4, 1861 and 1885. | |
| Longest season | | | 5 mos. and 18 days, 1846. |
| Shortest " | | | 4 " 8 " 1838. |

The Churchill river while it may be valuable as a source of power is not likely to ever furnish a means of communication inland by water.

Port Nelson is situated at the mouth of Nelson river in approximately latitude 57° and about eighteen miles from the better known Hudson bay post of York at the mouth of Hayes river.

The area available for townsite and railway terminal development was found to be practically unlimited on either side of the Nelson river or on both sides. Some drainage would be required but could be easily done. Outside of this the situation is entirely satisfactory both from the standpoint of cost and convenience. The rail haul from The Pas is 420 miles with easy curvature and maximum gradients of $\frac{1}{10}$ of 1 per cent both ways.

Near the mouth of the river at Beacon point a shoal or bar exists where the depth of water falls to about 17 feet at low tide although a narrow deeper channel appears to exist at either side. Inside the bar the water deepens to as much as 90 feet and a depth of 22 feet may be carried for upwards of twelve miles from Beacon point. Beyond this the water shoals to 19 or 20 feet at the proposed dock site some fifteen miles from Beacon point.

With the channel properly buoyed and marked any ship likely to come to Hudson bay may safely enter Nelson river drawing from 22 feet to 24 feet of water for 18 hours out of 24.

Considerable dredging will be required in the channel near the proposed docks and to provide a turning basin and anchorage for loading ships. If the route is successful it will probably also require the dredging of a channel through the outer bar and the removal of some shoal spots in the inner channel.

The material to be dredged is clay and can probably be done by suction dredges at a very low cost.

A breakwater will be necessary for the protection of small craft but at the present time ocean going ships would find the anchorage good without the breakwater. The large ocean waves or swells break on the outer bar outside of Beacon point, and although under certain conditions of tide and wind a nasty sea may arise inside, it is probably only a surface agitation as distinct from deep sea waves and will probably only trouble small craft.

At ebb tide the strongest currents are about $3\frac{1}{2}$ miles per hour.

No signs of ice shoves can be found. The Hudson Bay Railway survey party stationed at Nelson during the winter of 1908 to 1909 found the channel open up to the proposed dock site all winter. Some loose ice drifted up and down with the tides but did not jam. In the spring of 1909 the river was clear of ice as far as Flamboro head by May 1, the immense volume of water discharged by Nelson River carrying it well out to sea, so that during the summer of 1909 at any rate the smaller sailing ships and steam craft would have been free to carry on local development work from about May 1.

From the Hudson Bay Company's records at York Factory, and other reliable authorities, it is apparent Port Nelson will be available for at least 7 months each year, and possibly eight months in favourable seasons.

Port Nelson is situated at the mouth of one of the largest rivers in the world, and one which some day may be converted into a highway for ships into the interior. The following comparison with the proposed Georgian Bay canal may illustrate this better than any other method:—

| | |
|--|------------|
| Distance from Lake Winnipeg to Hudson bay via Nelson river.. | 410 miles. |
| “ “ Georgian bay to Montreal.. | 440 “ |
| Number of locks required via Nelson river.. | 23 “ |
| “ “ “ Georgian bay canal.. | 27 “ |
| Highest single lift via Nelson river.. | 45 feet. |
| “ “ “ Georgian bay canal | 60 “ |
| Total lift Hudson bay to Lake Winnipeg.. | 700 “ |
| “ “ Montreal to Georgian bay.. | 760 “ |

On Nelson river no problem of a sufficiency of water to get over a watershed will be met with as the full flow of the river is available from the commencement.

In a recent report of the Conservation Commission the estimated available horse-power of the rivers of Canada was given as 16,000,000 one-third of which, or over 5,000,000 horse-power, being credited to Nelson river.

With this brief resume of the essential points in connection with the two harbours, and keeping in view the definition of the problem to be considered, the following comparison may be made:

The area available for terminal development at Churchill is very restricted, and expensive to improve unless selected six miles from the dock-site.

The area available at Nelson is unlimited and easy to improve and available at any point most desirable.

The area available for docks at Churchill is very small, and at the present time suitable only for ships not drawing over 18 feet of water. Indications are that the deepening of this area and further extensions may require to be made in solid rock at great expense.

The area available at Nelson is about eight miles on each side of the river, or a total of sixteen miles of dock frontage. A large amount of dredging to be done for harbour basin, slips and channel, but in material which can be handled by suction dredges. This is usually done for 7 cents to 10 cents per cubic yard. Allowing for the great distance Nelson is from outfitting points the cost of this dredging should not exceed 25 cents or 30 cents per cubic yard.

The harbour at Churchill is protected by a breakwater, but owing to the deep water at the entrance a certain amount of swell occurs throughout the harbours during bad storms.

Port Nelson will require the construction of a breakwater to shelter small craft, but even at the present time the dock site is so far inland as to be free from any sea which might inconvenience an ocean going ship. It is not intended to convey the impression that the swell at Churchill is a serious drawback. Churchill has always been described as a perfect harbour, but as a matter of fact as far as ocean going ships are concerned when once in Nelson they are quite as well if not better situated than at Churchill to ride out a storm.

Churchill Harbour is swept by very strong and dangerous currents, so much so that the captain in charge of the *Stanley* for the Department of the Naval Service suggests the construction of a dam across the harbour in order to better this condition. The only suitable site for this dam would require one a mile and a half long, and the cost of constructing this dam would appear to about balance the cost of constructing a breakwater a mile and a half long at Nelson.

This dam would also mean the diverting of the Churchill river across the middle of what has already been described as an unsuitable site for railway terminals.

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The best authorities on the length of open season at Churchill and Nelson places that of Churchill at an average of about five months, sometimes falling to a little over four months, with occasional ice blockades during the summer months, at any rate serious enough to interfere with the smaller variety of sailing ships and steam craft.

The same authorities place the open season at Nelson at not less than seven months and possibly eight months in favourable seasons.

The crux of the situation heretofore has always been considered the length of season Hudson straits can be used. This is variously estimated to be from $3\frac{1}{2}$ months to seven or eight, and probably lies somewhere between the two. It thus appears as though Churchill harbour may not always be open as long as the straits. Port Nelson undoubtedly is available at any time a ship can pass through the straits, and no doubt will be available for ships engaged in local development for at least two months longer than Churchill.

From the foregoing it would appear as though the only advantage which Churchill might claim is a ready made breakwater, the advantage in every other respect lying with Port Nelson. With this breakwater at Churchill it is likely that the initial work there may be easier than at Nelson.

Development to handle 5,000,000 or 10,000,000 bushels of grain might be easier at Churchill than Nelson, but if this route is to have any appreciable effect upon the transportation problem of the west, provision must be made to handle not less than 50,000,000 or 60,000,000 bushels, and that in the short time of 60 days or thereabouts. Works and equipment for such a traffic can be much more readily obtained at Nelson than at Churchill.

There is no doubt but what the present exposed situation of Nelson may occasion more or less physical discomfort or inconvenience in the initial stages of the work, but to one who can ignore that and keep only in view the ultimate utility of the route, there seems to be no other course than to recommend Port Nelson as the terminus.

J. ARMSTRONG,
Chief Engineer H. B. Ry.

